

DIVISION 26 - ELECTRICAL

SECTION 26 41 01.00 10
LIGHTNING PROTECTION SYSTEM

A. GENERAL

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition
NFPA 780 (2007) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Standard for Grounding and Bonding Equipment
UL 96 (2005) Standard for Lightning Protection Components
UL 96A (2007) Standard for Installation Requirements for Lightning Protection Systems
UL Electrical Construction (2008) Electrical Construction Equipment Directory

SUBMITTALS

Submit the following in accordance with Section 1B, Shop Drawings/Submittals:

Shop Drawings: Detail drawings as specified.

Certificates:

Materials: Provide proof of compliance with requirements of UL where material or equipment is specified to comply. The label of or listing in UL Electrical Construction will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. Submit a letter of findings certifying UL inspection of lightning protection systems provided on the following facilities.

Project Completion: A UL Lightning Protection Inspection Certificate shall be submitted to the Government Construction Representative.

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced installer who is Nationally Recognized Testing Laboratory (NRTL) listed or who is certified by the Lightning Protection Institute (LPI) as a Master Installer/Designer.

Submit detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

B. PRODUCTS

STANDARD PRODUCTS

Provide a system consisting of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and which is the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

MATERIALS

General Requirements

Do not use any combination of materials that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture, unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist, which would cause corrosion of conductors, use conductors with protective coatings or oversize conductors. Where a mechanical hazard is involved, increase the conductor size to compensate for the hazard or protect the conductors by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

Copper

Copper conductors used on nonmetallic stacks shall weigh not less than 375 pounds/thousand feet, and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 1/0 AWG.

Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, strips that are much wider than solid strips shall be. A strip width that is at least twice that of the diameter of the perforations shall be used. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 1-1/2 inch wide.

Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. Air terminals more than 24 inch in length shall be supported by a suitable brace, with guides not less than one-half the height of the terminal.

Ground Rods

Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to IEEE C135.30. Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous and solid copper shall not be mixed on the job.

Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation. Clamp-type connectors shall only be used for the connection of the roof conductor to the air terminal. All other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be listed for the purpose. The high compression fittings shall be the type requiring a hydraulically operated mechanism to apply a minimum of 10,000 psi.

Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

C. EXECUTION

EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

INTEGRAL SYSTEM

General Requirements

Provide a lightning protection system consisting of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 2 feet from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 2 feet in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 25 feet. In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 2 inch for each foot of increase over 25 feet. On large, flat or gently sloping roofs, as defined in NFPA 780, air terminals shall be placed at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, smokestacks, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, air terminals shall be mounted thereon, where practicable. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom. Where metal ventilators are installed with air terminals mounted thereon, the air terminal shall not be more than 24 inch away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement. Where metal ventilators are installed with air terminals mounted adjacent, the air terminal shall not be more than 24 inches away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement.

Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 8 inch. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, there shall be at least one additional down conductor for each additional 50 feet of length or fraction thereof. On rectangular structures having French, flat, or saw tooth roofs exceeding 250 feet in perimeter, there shall be at least one additional down conductor for each 100 feet of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each wing. On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 100 feet. On structures exceeding 50 feet in height, there shall be at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application shall not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 16 feet in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure.

Interconnection of Metallic Parts (Not Used)

Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

Grounding Electrodes

A grounding electrode shall be provided for each down conductor. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, or more than 8 feet, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 25 ohms if a counterpoise is not used. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 24 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 25 ohms, the Contracting Officer shall be notified immediately. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radically from the building. The lower ends of the down conductors are then buried in the trenches.

1 Metal Roofs (Not Used)

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3 Metal Roofs with Metal Walls (Not Used)

4
5 Steel Frame Building (Not Used)

6
7 Ramps (Not Used)

8
9 Igloo-Type Magazines (Not Used)

10
11 Tanks and Towers (Not Used)

12
13 Stacks

14
15 Metal guy wires for stacks shall be grounded. Metal guy wires or cables attached to steel anchor rods set in
16 the earth will be considered as sufficiently well grounded. Metal guy wires or cables attached to anchor rods
17 set in concrete or attached to buildings or nonconducting supports shall be grounded to a ground rod driven
18 full length into the ground.

19
20 Metal Stacks

21
22 Metal smokestacks shall be electrically continuous and be grounded. Where the construction of the
23 foundation does not provide 25 ohms maximum to ground, the stack shall be grounded to two ground rods
24 driven full length into the earth. Ground rods shall be located approximately 180 degrees apart and shall be
25 set not less than 3 feet from the nearest point of the stack foundation.

26
27 Nonmetallic Stacks

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29 On nonmetallic smokestacks constructed of brick, hollow tile, or concrete, the air terminals shall be made of
30 solid copper, copper alloy, stainless steel or Monel metal. Air terminals shall be uniformly distributed about
31 the rim of the stack at intervals not exceeding 8 feet and shall extend 18 to 30 inch above the stack if side
32 mounted or 18 inch above the stack if top mounted. Air terminals shall be at least 5/8 inch in diameter,
33 exclusive of the corrosion protection. Top-mounted air terminals shall not extend more than 18 inch above
34 the top of the stack. The air terminals shall be electrically connected together by means of a metal band or
35 ring to form a closed loop about 2 feet below the top of the stack. Where the stack has a metal crown, the air
36 terminals shall be connected thereto. Where stacks have a metal lining extending part way up, the lining
37 shall be connected to the air terminal at its upper end and grounded at the bottom. At least two down
38 conductors shall be provided on opposite sides of the stack leading from the ring or crown at the top to the
39 ground. When the stack is an adjunct of a building near or touching the building perimeter, one of the down
40 conductors shall be extended directly to a ground connection while the other may be connected to a lightning
41 protection system on the building. Joints in conductors shall be as few as practicable and shall provide
42 strength in tension equal to that of the conductor. Fasteners of copper or copper-bronze alloy shall be
43 spaced not over 3 feet apart for vertical conductors and not over 2 feet apart for horizontal conductors. To
44 prevent corrosion by gases, copper air terminals, conductors, and fasteners within 25 feet of the top of the
45 stack shall have a continuous covering of lead at least 1/16-inch thick. Stacks partly or wholly of reinforced
46 concrete shall conform to the requirements for nonmetallic stacks, and in addition, the reinforcing steel shall
47 be electrically connected to down conductors at the top and bottom of the concrete.

48
49 POST TENSIONING SYSTEMS (Not Used)

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51 RAILROADS (Not Used)

52
53 PIERS AND WHARVES (Not Used)

54
55 INTERCONNECTION OF METAL BODIES (Not Used)

56
57 FENCES (Not Used)

58
59 EXTERIOR OVERHEAD PIPE LINES (Not Used)

1 SEPARATELY MOUNTED SHIELDING SYSTEM, MAST-TYPE (Not Used)

2
3 SEPARATELY MOUNTED SHIELDING SYSTEM, OVERHEAD GROUND-WIRE TYPE (Not Used)

4
5 INSPECTION

6
7 The installed lightning protection system shall be inspected and approved by a certified UL inspector.